


# Forest Management Sequestration Methods

Timothy Robards, Ph.D.


California Dept. of Forestry & Fire Protection  
Fire & Resource Assessment Program

The Potential of Terrestrial Carbon Sequestration Methods as Options for  
Climate Change Mitigation


Integrated Energy Policy Report Workshop  
May 26, 2009, Sacramento  
California Energy Commission

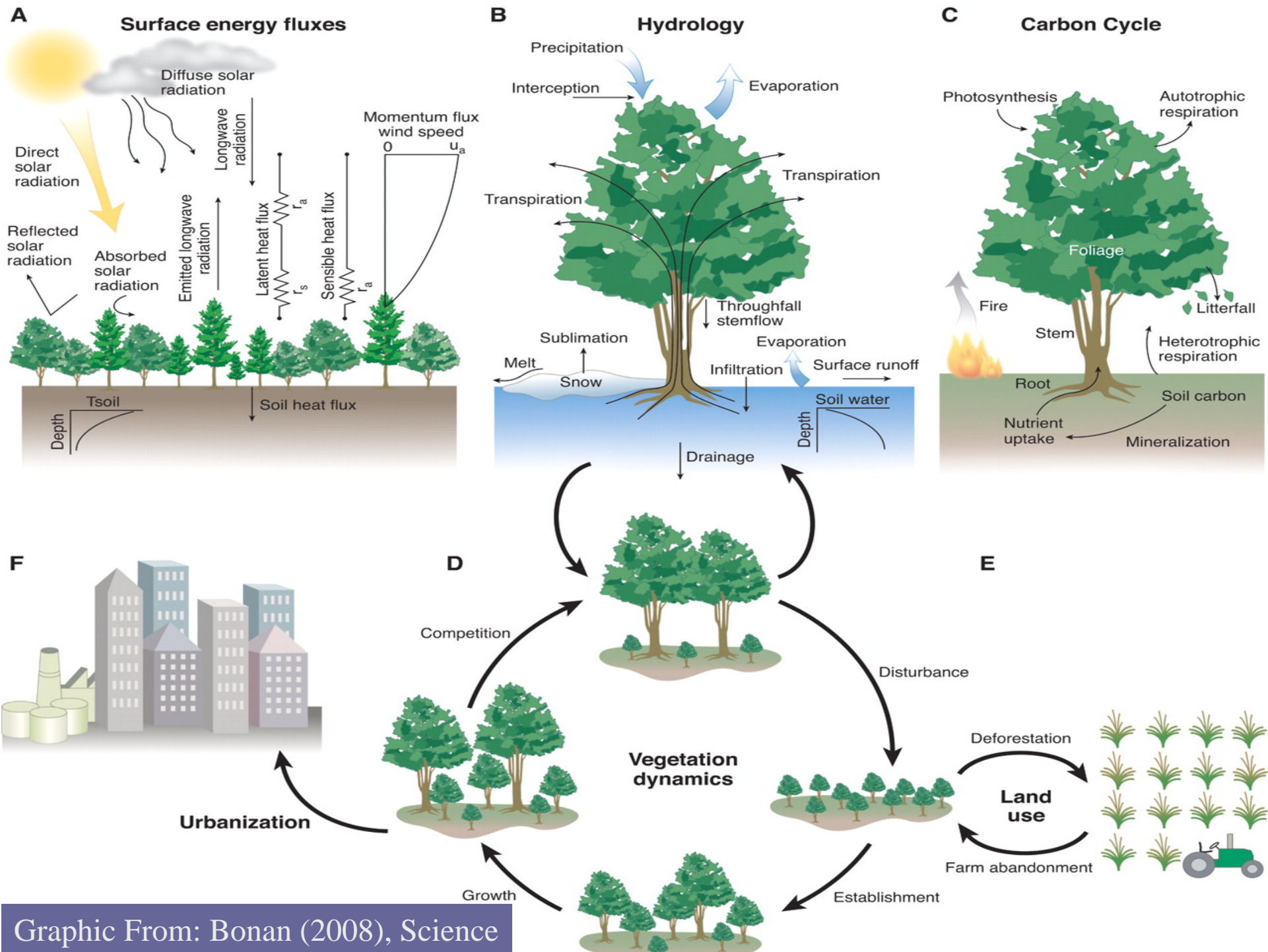
A stylized, layered mountain range graphic in shades of teal and blue, located in the bottom right corner of the slide.

# Presentation Outline

- ◆ What is forest carbon sequestration?
  - ◆ How do forests affect climate change?
  - ◆ Where are California's forests?
  - ◆ What forest management methods affect sequestration?
  - ◆ What is the up and the down side potential?
  - ◆ What are the policy options?
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the text area.

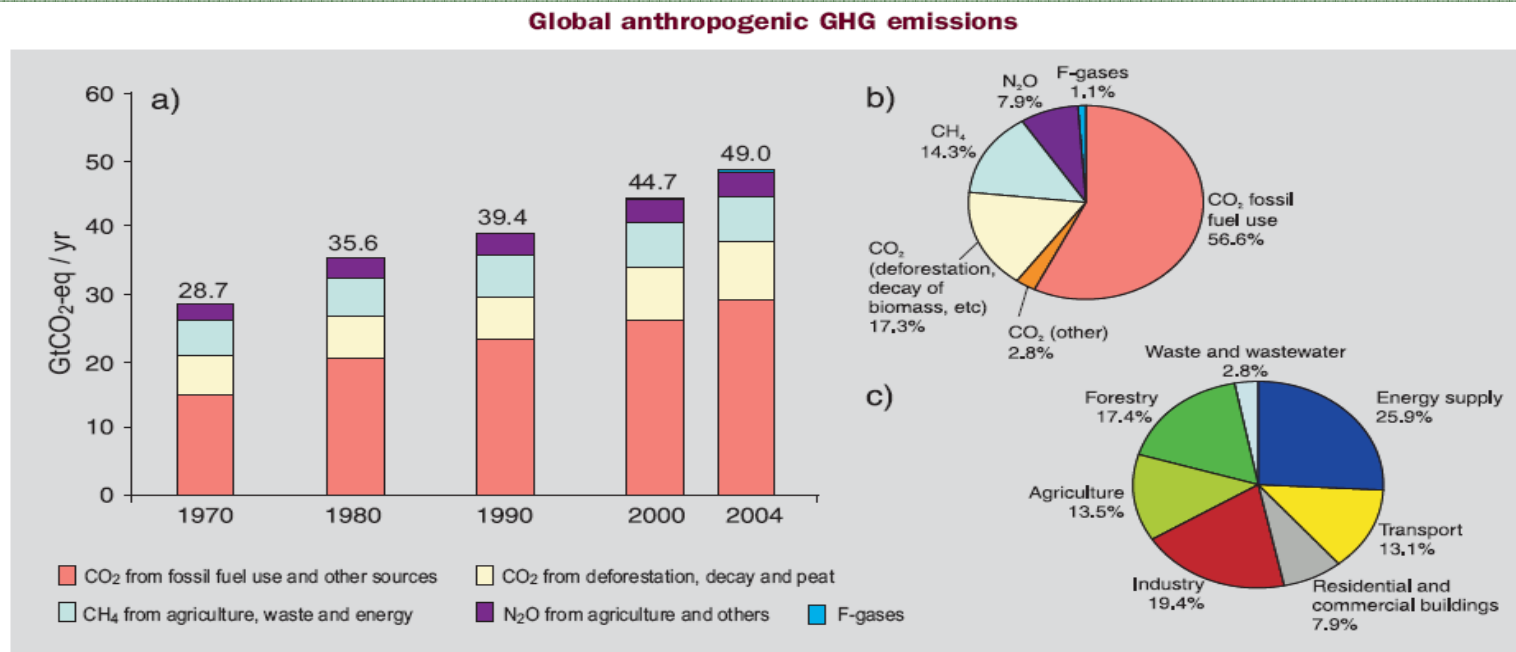
# What is forest carbon sequestration?

- ◆ Conversion of atmospheric carbon (CO<sub>2</sub>) to complex molecules in trees.
  - ◆ Forest carbon pools
    - Bole or stem (live)
    - Crown: branches and leaves
    - Litter and duff
    - Below ground: roots and soil
    - Dead wood (standing and down)
    - Wood products, landfills, biomass
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the text area.



# Forests Globally

“...the amount of carbon dioxide in the atmosphere has increased by about 35% in the industrial era, and this increase is known to be due to human activities, primarily the combustion of fossil fuels and removal of forests. Thus, humankind has dramatically altered the chemical composition of the global atmosphere with substantial implications for climate.”



**Figure 2.1.** (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004.<sup>5</sup> (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO<sub>2</sub>-eq. (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO<sub>2</sub>-eq. (Forestry includes deforestation.) {WGIII Figures TS.1a, TS.1b, TS.2b}

From IPCC 2007 Fourth Assessment Report, ch. 1 and Synthesis Report, ch. 2.



# California Forests

- ◆ 12.4 million hectares
- ◆ Nearly 1/3 of California Land Base
- ◆ Water, Wood Products, Recreation, Ecosystem
- ◆ Urban Forests (5% of Land Base)
- ◆ Store 8.5 Billion Tonnes of CO<sub>2</sub>e

“In 2003, growing vegetation in North America removed approximately 500 million tons of carbon per year ( $\pm 50\%$ ) from the atmosphere and stored it as plant material and soil organic matter. This land sink is equivalent to approximately 30% of the fossil-fuel emissions from North America.” Source: The First State of the Carbon Cycle Report (2007)

# Forested Ecosystems of California





# Carbon Stored in California Forests

Table 4—Estimated total carbon on forest land by ownership and carbon pool in California

Ownership	Forest area	Aboveground live tree biomass <sup>a</sup>	Below- ground biomass	Under- story vegetation	Dead wood	Soil organic	Litter	Total
	<i>Million acres</i>	<i>-----Teragrams carbon-----</i>						
National forest:								
Timberland	9.275	354.73	88.99	13.91	89.52	155.81	96.59	799.55
Other unreserved	2.265	20.61	5.48	30.69	3.18	16.95	12.38	89.28
Other reserved	3.366	115.29	29.88	11.06	30.46	53.01	36.34	276.04
Other public:								
Timberland <sup>b</sup>	0.428	15.92	3.39	0.58	3.32	7.18	4.99	35.39
Other unreserved	1.795	12.48	2.73	10.17	1.58	13.02	8.55	48.53
Other reserved	2.485	113.17	24.37	25.43	22.25	37.93	28.58	251.73
Private:								
Timberland <sup>b</sup>	7.542	280.55	59.79	10.18	58.54	126.54	88.01	623.60
Other unreserved	5.660	68.53	17.04	11.55	10.32	57.30	39.98	204.72
Subtotals								
Timberland	17.245	651.20	152.17	24.67	151.39	289.53	189.59	1,458.54
Other unreserved	9.720	101.62	25.25	52.41	15.07	87.27	60.91	342.52
Other reserved	5.851	228.45	54.25	36.49	52.72	90.94	64.92	527.77
Total	32.816	981.28	231.66	113.56	219.17	467.74	315.42	2,328.83
Total CO <sub>2</sub> equivalent <sup>c</sup>		3,601.28	850.21	416.78	804.37	1,716.59	1,157.58	8,546.82

<sup>a</sup> The live tree aboveground biomass is calculated based on the equations developed by Pacific Northwest Research Station Forest Inventory and Analysis Program (PNW-FIA).


<sup>b</sup> Timberland area and carbon density for other public and private (outside national forest) use 1994 change database data from PNW-FIA.

<sup>c</sup> Total carbon dioxide (CO<sub>2</sub>) equivalent is calculated, in terragrams, as 3.67 times Tg carbon.

Source: Fried and Zhou (2008)



# Forest Management Methods

- ◆ Avoided deforestation
  - ◆ Afforestation and Reforestation
  - ◆ Forest management
    - Natural stands & Plantations
    - Resiliency (to disturbance)
    - Adaptation
    - Site occupancy
    - Species composition
    - Wood products
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the background.

# Consider History

Mr. Coert DuBois, Associate District Forester, discussed the question of forest fires. Unless fires can be kept out of the forests it is impossible to practice forestry on them. To actually protect against fire is thus the first duty of the forester. The

Forest Supervisors Meeting, San Francisco 1911

## RESULTS OF "LIGHT BURNING" NEAR NEVADA CITY, CALIFORNIA.

By M. B. PRATT.

It is a common practice for ranchers living in the vicinity of Nevada City to burn over their wood lands in the spring, generally in early April. They contend that the burning does not damage the timber to any extent and affords protection against fires in the dry season. The land burned over is stocked with

Journal of Forestry, 9(3), 1911

# Potential Sequestration

- ◆ Concept of No Net Loss
  - In Growth or Sequestration
  - In Stocks
- ◆ Defensive posture
  - Protect existing stocks
    - ◆ AB32 2020 Target Reductions = 174 Tg CO<sub>2</sub>e/year
    - ◆ California Aboveground Forest Stocks = 5,980 Tg
  - Adaptation planning
- ◆ Offensive posture
  - Maximize sequestration
- ◆ Protect and enhance
  - Biological, ecological, social, economic, etc.

# Policies

- ◆ AB 32 Scoping Plan
  - Conservation
  - Forest Management
  - Reforestation
  - Afforestation Urban Forestry
  - Fuels Management
- ◆ Requires State/Federal Coordination
- ◆ Measuring progress: Inventory and Monitoring




# Interagency Forestry Working Group (IFWG)

- ◆ California Board of Forestry & Fire Protection
- ◆ California Natural Resources Agency
- ◆ Members
  - Cal/EPA, Cal Fire, ARB, DFG, DWR, CEC, USDA Forest Service
- ◆ Purpose: provide recommendations and technical information to assist the Board in achieving AB32 and adaptation strategies

# IFWG Principles

- ◆ Protection and Conservation
  - ◆ Resilience
  - ◆ Restoration
  - ◆ Utilization
  - ◆ Mitigation
  - ◆ Adaptation
- 
- ◆ Track progress on [www.bof.fire.ca.gov](http://www.bof.fire.ca.gov)

# More to Come...

- ◆ CARB Cap and Trade Program
    - Targets
    - Offsets
  - ◆ Western Climate Initiative
  - ◆ Revised CAR forest protocols
  - ◆ Revised forest sector inventory
  - ◆ National
  - ◆ International
- 
- A stylized, layered mountain range graphic in shades of teal and blue, located in the bottom right corner of the slide.

# Questions/Comments

Tim Robards

[tim.robards@fire.ca.gov](mailto:tim.robards@fire.ca.gov)

